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U.S. PATENT APPLICATION

for

ELECTRONIC SYSTEM WITH A MOVABLE PRINTED CIRCUIT ASSEMBLY

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ELECTRONIC SYSTEM WITH A MOVABLE PRINTED CIRCUIT ASSEMBLY

BACKGROUND OF THE INVENTION

[0001] Electronic systems, such as computer systems, typically include one or more printed circuit boards upon which are affixed active and passive components. In many systems which utilize a plurality of such printed circuit boards, the printed circuit boards are arranged parallel to one another and are directly connected to one another. In many applications, high density connectors are required to provide adequate connection between the parallel printed circuit boards. Such high density connectors require relatively large amounts of force to ensure proper mating of the connectors. Similarly, large forces are also required to pull apart or unmate the connectors when one of the parallel cards needs to be repaired or replaced.

[0002] Connection of the parallel boards is typically accomplished either manually or by using a jack screw. To manually connect the boards, the upper printed circuit board is grasped and lowered so as to position adjacent connectors of the parallel boards in mating engagement. Unfortunately, in many applications the boards are extremely heavy, making assembly difficult and increasing the chance of damage due to misalignment of the connectors or a user's hand slipping and dropping the upper board.

[0003] A jack screw typically includes a single screw with mechanical details to allow the jacking screw to push or pull on metal blocks mounted to both printed circuit assemblies and to provide a force to assist in mating or unmating the connectors. Unfortunately, the large mating forces required of high density connectors are difficult to achieve with typical jacking screws. The jacking screw method also typically requires tools which makes assembly and servicing difficult. In addition, both methods fail to keep the assemblies parallel enough

to prevent gross and latent defects to the pins and housing of the connector sets or connections to the printed circuit boards.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] FIGURE 1 is a top plane view of an example of an electronic system of the present invention.

[0005] FIGURE 2 is a sectional view of the electronic system of FIGURE 1 taken along line 2—2, illustrating the system component in a disconnected state.

[0006] FIGURE 3 is a sectional view of the electronic system of FIGURE 1 taken along line 2—2, illustrating the system component in a connected state.

[0007] FIGURE 4 is a top plane view of an alternative embodiment of the electronic system of FIGURE 1.

DETAILED DESCRIPTION OF THE EXAMPLE EMBODIMENTS

[0008] FIGURES 1-3 illustrate electronic system 10 which generally includes chassis 12, system component 14, alignment guides 16, members 18, springs 20, system component 24, link 26 and pivoting member 28. Chassis 12, system component 14 and pivoting member 28 form a first part of an electronic system which cooperates with a second part of the electronic system including system component 24 and link 26. Chassis 12 generally comprises a structure including of one or more members configured to support system component 14. In particular embodiments, chassis 12 may additionally be configured to house system component 14 as well as system component 24. Chassis 12 is formed from sheet metal. In alternative embodiments, chassis 12 may be substantially formed from a variety of other materials.

[0009] System component 14 generally comprises a main functional component of electronic system 10 that is configured to cooperate with system component 24. To facilitate such cooperation, system component 14 includes connector 30. Connector 30 is configured to connect or mate with an opposite connector 32 of system component 24. In the embodiment illustrated,

connector 30 comprises a high density connector. In alternative embodiments, connector 30 may comprise other conventionally known or future developed connectors configured to facilitate the transmission of data signals between system components.

[0010] In the particular embodiment illustrated, system component 14 comprises a printed circuit assembly having connector 30. System component 14 additionally includes printed circuit board 34 and one or more components 36. Printed circuit board 34 generally extends along a plane 41. Printed circuit board 34 is stationarily supported relative to chassis 12 and has a face 30 facing system component 24 and an opposite face 40. As shown by FIGURES 2 and 3, connector 30 extends from face 30, while components 36 extend from face 40. Components 36 comprise conventionally known or future developed active or passive components affixed to face 40 of printed circuit board 30. Although not illustrated, additional active or passive components may be affixed to face 30 of printed circuit board 34.

[0011] Alignment guides 16 guide movement of system component 24 towards and away from system component 14 to facilitate proper mating of connectors 30 and 32. In the particular embodiment illustrated, alignment guides 16 comprise a plurality of spaced pins slidably passing through system component 24. In alternative embodiments, alignment guides 16 may comprise pins fixed to system component 24 and slidably passing through system component 14, such as through printed circuit board 34. Although system 10 is illustrated as including four spaced alignment guides 16, system component 10 may include a greater or fewer number of such guides. Moreover, although guides 16 are illustrated as generally extending from surface 38 of printed circuit board 34, alignment guides 16 may alternatively extend from chassis 12 through printed circuit board 34 or may extend from chassis 12 about a perimeter of printed circuit board 34. Although alignment guides 16 are illustrated as pins, alignment guides 16 may alternatively comprise various other structures coupled between chassis 12 or other structures stationarily affixed to chassis 12 and system component 24. For example, in alternative

embodiments, chassis 12 may include one of a tongue and a groove, while system component 24 includes the other of a tongue and a groove, wherein the tongue and the groove slidably mate to guide movement of system component 24 relative to system component 14.

[0012] Stop members 18 comprise members providing stop surfaces 44 configured to abut system component 24 or a surface coupled to system component 24. Stop surfaces 44 generally extend in alignment with a plane at which connector 32 is fully engaged or mated with connector 30. In other words, when connector 32 is fully mated or engaged with connector 30, the lower end of connector 32 is spaced from face 38 by a distance D as shown in FIGURE 3. Surface 44 is also spaced from face 38 by the same distance D. Stop surfaces 44 indicate when system component 24 has been moved such that connector 32 is in complete or satisfactory mating engagement with connector 32. Stop surfaces 44 prevent damage to connectors 32 or 30 caused by an individual attempting to move system component 24 too close to system component 14.

[0013] Springs 20 generally comprise compression springs having a lower end 46 seated within countersinks 48 formed within members 18 and an upper end 50 bearing against system component 24 or a structure coupled to system component 24. Springs 20 extend about alignment guides 16. Springs 20 provide force to system component 24 based upon weight variances across component 24 to maintain system component 24 in a level orientation as system component 24 is lowered or otherwise moved toward system component 14 and to ensure that connectors 32 and 30 are in proper alignment when joined. Springs 20 have a spring constant such that springs 20 do not provide a substantial force against system component 24 which would inhibit movement of system component 24 towards system component 14 or which would cause disconnection of connectors 32 and 30 once connected.

[0014] Although alignment guides 16, stop surfaces 44 and springs 20 are illustrated as concentrically extending about common axes, each of such elements may be separately provided along system component 14. For

example, stop members 18 providing stop surfaces 44 may be spaced from alignment guides 16 and springs 20 may extend along axes distinct from the axes of alignment guides 16 and spaced from members 18.

[0015] As shown by FIGURES 2 and 3, springs 20 compress as system component 24 is moved into closer proximity with system component 14. Although less desirable, system 10 may alternatively omit one or more of alignment guides 16, springs 20 or members 18. For example, stop member 18 may be omitted in embodiments wherein spring 20 prevents excessive movement of system component 24 towards system component 14. Springs 20 may be omitted in embodiments where guides 16 maintain a proper orientation of connector 32 during movement of system 24.

[0016] System component 24 comprises any one of a variety of main system components having a connector 32 configured to connect to another connector 30 of another system component, such as system component 14. For purposes of this disclosure, a system component is a component which performs one or more functions for an electronic system and which transmits or receives data signals to or from another system component through a pair of mating connectors which releasably connect to one another. In the particular embodiment illustrated, system component 24 comprises a printed circuit assembly including connector 32, printed circuit board 54 and components 56. Printed circuit board 54 has a face 58 from which connector 32 extends. Face 58 faces face 38 of printed circuit board 34. Printed circuit board 54 further includes an opposite face 60 from which components 56 extend. Printed circuit board 54 generally extends along a plane 57 which is parallel to the plane 41 in which printed circuit board 34 extends. Alignment guides 16 and springs 20 further assist in maintaining printed circuit board 54 parallel to printed circuit board 34 as printed circuit board 54 is moved towards printed circuit board 34.

[0017] Components 56 comprise conventionally known or future developed active or passive components affixed to surface 60. In alternative embodiments, components 56 may additionally or alternatively be affixed to surface 58 of printed circuit board 54.

[0018] Link 26 comprises one or more structures coupled to system component 24 and in slidable engagement with pivot member 28. In the particular embodiment illustrated, link 26 is directly coupled to a stiffener 64 which is coupled to printed circuit board 54. Stiffener 64 extends opposite connector 32 and stiffens board 54 adjacent to connector 32 while providing a rigid structure supporting link 26. Although less desirable, in alternative embodiments, stiffener 64 may be omitted.

[0019] As shown by FIGURE 2, link 26 includes neck portion 66 and head portion 68. Neck portion 66 and head portion 68 cooperate with pivot member 28 to facilitate slidable movement of link 26 relative to pivot member 28. To assist in maintaining printed circuit board 54 in a level orientation such that printed circuit board 54 remains parallel to printed circuit board 34 during movement of printed circuit board 54, link 26 is coupled to system component 24 at a center of mass of system component 24. Although less desirable, link 26 may alternatively be coupled to system component 24 or other locations.

[0020] Pivot member 28 generally comprises an elongate member or lever pivotably supported relative to system component 24 and slidably engaging head portion 68 of link 26. As best shown by FIGURES 2 and 3, pivot member 28 is pivotably coupled to chassis 12 for pivotal movement about axis 72 and includes channel 74. Channel 74 generally comprises an elongate slot, cavity or opening formed within pivot member 28 and configured to slidably receive and capture head portion 68 of link 26. In particular, channel 74 has a narrower constricted portion 76 through which neck portion 66 of link 26 extends. Channel 74 also includes an enlarged chamber 78 which receives head portion 68. Head portion 68 is larger than constricted portion 76 in at least one direction such that head portion 68 is slidably captured within channel 74.

[0021] FIGURES 2 and 3 further illustrate the use of pivot member 28 to disconnect and connect connectors 32 and 30, respectively. As shown by FIGURE 2, connector 32 is disconnected from connector 30 by pivoting pivot member 28 in the direction indicated by arrow 82 about axis 72. As a result, constricted portion 76 of channel 74 engages the lower surface of head 68 to

exert a force upon link 26. As pivot member 28 rotates about axis 72, head 68 slides within channel 74 in the direction indicated by arrow 84. As a result, pivoting of pivot member 28 exerts a force upon link 26 and upon system component 24 in a vertical direction indicated by arrow 86, resulting in connector 32 being lifted from connector 30 in a direction perpendicular to plane 41 of printed circuit board 34.

[0022] To connect connector 32 to connector 30, pivot member 28 is pivoted about axis 72 in the direction indicated by arrow 90. This results in surface 92 of channel 74 engaging a top portion of head 68 to exert a force upon link 26. Once again, head portion 68 slides within channel 74 such that the force exerted by pivot member 28 is transmitted to link 26 in the direction indicated by arrow 94 generally perpendicular to the printed circuit board 34. In short, the sliding interaction of link 26 with channel 74 enables force to be applied to connector 32 in directions perpendicular to connector 30 to ensure proper alignment and mating of connectors 32 and 30. Because pivot member 28 provides a lever arm, pivot member 28 multiplies the actual manual force applied by an individual directly to grip portion 95. This larger multiplied force is applied to link 26 and system component 24 to achieve the relatively large mate or un-mate forces required of connectors 32 and 30. Electronic system 110 is especially advantageous for mating connectors of parallel printed circuit assemblies which are relatively large, which are difficult to maneuver and manipulate and which usually require high density connectors having extremely large required mate and un-mate forces. Electronic system 10 further facilitates tool-less connection of connectors 32 and 30.

[0023] Although pivot member 28 is illustrated as having a channel 74 which extends both above and below head 68 to engage the top surface and the bottom surface of head 68, this slidable relationship between link 26 and pivot member 28 may have other configurations. For example, neck portion 66 of link 26 may additionally include a collar having a diameter greater than neck portion 66 and spaced below head 68, wherein constricted portion 76 is captured between head 68 and the collar. In such an alternative embodiment, a lower

surface of constricted portion 76 would engage the collar during pivotal movement of pivot member 28 in the direction indicated by arrow 90, while the upper surface of constricted portion 76 would engage the lower surface of head 68 when pivot member 28 is pivoted in the direction indicated by arrow 82. In such an alternative embodiment, pivot member 28 may alternatively be configured such that link 26 extends completely through pivot member 28.

[0024] As further shown by FIGURES 2 and 3, constricted portion 76 additionally includes a spring-loaded gate 96 which pivots about an axis 98. An example of a gate may be a carabiner style gate. Gate 96 pivots about axis 98 provided by a pin 99 between a closed position in which gate 96 rests upon landing 100 and in which head 68 is captured within channel 74 and an open position (shown in phantom) permitting head 68 and neck portion 66 to be withdrawn from channel 74. Gate 96 is biased to the closed position by gravity. In an alternative embodiment, gate 96 may be resiliently biased to the closed position by a spring. For example, a coil spring having one end coupled to gate 96 and the other end coupled to pivot member 28 may be provided. In alternative embodiments, other springs may be employed. Gate 96 permits link 26 to be removed or disconnected from pivot member 28. As a result, system component 24 may also be disconnected from pivot member 28, permitting system component 24 to be repaired and reconnected to pivot member 28 or replaced with another system component which may be connected to pivot member 28 for connection to system component 14. In the particular embodiment illustrated, link 26 is configured as a handle which facilitates manipulation of system component 24 when system component 24 is disconnected from system component 14 and removed from system 10. Although less desirable, link 26 may alternatively be permanently but slidably coupled to pivot member 28.

[0025] FIGURE 4 is a top plan view of electronic system 110, an alternative embodiment of system 10. Electronic system 110 is substantially identical to system 110 except that pivot member 28 pivots relative to system component 24 about axis 172 in lieu of axis 72 (shown in FIGURE 3). Axis 72 generally

extends parallel to a longitudinal axis of system components 14 and 26 which are illustrated as printed circuit assemblies. In alternative embodiments, system components 14 and 24 may comprise other conventionally known or future developed system components having connectors which must be connected to one another. Examples of such alternative system components include power supplies, hard disk drives, removable memory drives such as floppy drives, CD/DVD drives and the like. As noted above, electronic system 10 is particularly beneficial in connecting parallel printed circuit assemblies.

[0026] Although the present invention has been described with reference to example embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention. For example, although different example embodiments may have been described as including one or more features providing one or more benefits, it is contemplated that the described features may be interchanged with one another or alternatively be combined with one another in the described example embodiments or in other alternative embodiments. Because the technology of the present invention is relatively complex, not all changes in the technology are foreseeable. The present invention described with reference to the example embodiments and set forth in the following claims is manifestly intended to be as broad as possible. For example, unless specifically otherwise noted, the claims reciting a single particular element also encompass a plurality of such particular elements.